CATEGORY 1

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FACIL:50-305 Kewaunee Nuclear Power Plant, Wisconsin Public Servic 05000305
AUTH.NAME AUTHOR AFFILIATION
COLE,D.E. Wisconsin Public Service Corp.
MARCHI,M.L. Wisconsin Public Service Corp.
RECIP.NAME RECIPIENT AFFILIATION

SUBJECT: LER 98-004-00:on 980209,investigation found that fan's motor power circuit had failed in electrical containment penetration.Caused by poor electrical connection internal to penetration.Penetrations evaluated.W/980430 ltr.

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TITLE: 50.73/50.9 Licensee Event Report (LER), Incident Rpt, etc.

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NRC-98-45

Public Service Corporation

April 30, 1998

10 CFR 50.73

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Ladies/Gentlemen:

Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plant
Reportable Occurrence 1998-004-00

This event is being reported as a voluntary Licensee Event Report (LER). The attached describes a condition found which could have implications to other licensees as to the manner in which certain electrical containment penetrations manufactured by D. G. O'Brien, Inc, may degrade while in service.

Sincerely,

Mark L. Marchi
Manager - Nuclear Business Group

DEC

Attach.

cc - INPO Records Center
US NRC Senior Resident Inspector
US NRC, Region III

NRC FORM 366 (4-95) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 04/30/98

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS MANDATORY INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED BACK TO INDUSTRY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

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TITLE (4)

DG O'Brien Containment Electrical Penetration - Electrical Failure Potential (Voluntary LER)

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
									N/A	05000
02	09	1998	1998	-- 004 --	00	04	30	1998	FACILITY NAME	DOCKET NUMBER 05000

OPERATING MODE (9)	N	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)			
POWER LEVEL (10)	097	20.2201(b)	20.2203(a)(2)(v)	50.73(a)(2)(i)	50.73(a)(2)(viii)
		20.2203(a)(1)	20.2203(a)(3)(i)	50.73(a)(2)(ii)	50.73(a)(2)(x)
		20.2203(a)(2)(i)	20.2203(a)(3)(ii)	50.73(a)(2)(iii)	73.71
		20.2203(a)(2)(ii)	20.2203(a)(4)	50.73(a)(2)(iv)	X OTHER
		20.2203(a)(2)(iii)	50.36(c)(1)	50.73(a)(2)(v)	Specify in Abstract below or in NRC Form 366A
		20.2203(a)(2)(iv)	50.36(c)(2)	50.73(a)(2)(vii)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Dan E. Cole - Eng. & Tech. Support - Physical Change Process Leader	(920) 388-8659

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS
B	BD	PEN	0005	Y						

SUPPLEMENTAL REPORT EXPECTED (14)			EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE).	X	NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

On July 14, 1997, while at full-power operation, the 1B Containment Dome Vent Fan was found not operating; its power supply circuit breaker was found tripped. Investigation found that the fan's motor power circuit had failed in its electrical containment penetration. The penetration motor circuit utilizes two parallel #10AWG penetrations per motor phase. The heat generated in the penetration due the dome fan failure is believed to have caused an adjacent electrical connection's insulation to degrade. The containment penetration was integrity tested and found undamaged by the electrical failure. As near as can be determined the electrical failure was caused by a poor electrical connection internal to the penetration which may have caused an increased resistance on one of the parallel connections. The poor electrical connection was identified as the likely cause by the penetration manufacturer's (D.G. O'Brien) evaluation.

At the time of failure, the redundant dome fan remained operable. Although the redundant fan was found to have an electrical imbalance, the imbalance was within acceptable limits to ensure continued operation. With the redundant fan operable and the containment penetration's integrity assured, the plant remained within design basis when the failure occurred. This event is being voluntarily reported to provide other licensees who have similar penetration designs and applications of the potential for increased resistance in the penetrations.

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TEXT *(If more space is required, use additional copies of NRC Form 366A)* (17)

DESCRIPTION OF EVENT

On July 14, 1997, while at full-power operation, the 1B Containment Dome Vent Fan was found not operating. The cause of the event was determined to be electrical failure of the fan's 480VAC motor [MO] power circuit. Kewaunee has two 100% redundant Containment Dome Vent Fans. One fan is normally operating during power operation. The fans [FAN] are rotated on approximately two week intervals. Since Kewaunee has over twenty years of operation, each fan has approximately ten years of operating service. There have been no previous electrical penetration [PEN] failures or indication of degradation prior to this event. The failed fan manifested itself by an over current trip of the molded case circuit breaker [52] in the Motor Control Center (MCC) [ED] starter for the fan.

Troubleshooting isolated the circuit failure to be within the electrical containment [NH] penetration, penetration #A11; there was no visible evidence of penetration damage, and local leak-rate testing showed no loss of containment integrity within the penetration. The motor power circuit for both dome fans utilize two parallel #10AWG penetration conductors per motor phase; the parallel conductors are used to attain the required motor full load current for the penetration circuit.

The penetration circuit for the redundant 1A Containment Dome Vent Fan, penetration #F12, was inspected while the fan was in operation. One motor phase revealed an unexpectedly high ratio of current split between the two parallel #10AWG penetration conductors; the condition of the circuit was evaluated, and the circuit was determined to be degraded, but operable.

All other motor power circuits within the A11 penetration were inspected for insulation resistance, and the motor circuit for motor operated valve (MOV) SI-20B (1B Safety Injection Accumulator discharge) was found to be degraded by MEGGER test. The degradation was not severe, and evaluation of the circuit condition determined it to be degraded, but operable.

Both dome fans have been rewired to spare conductors within their respective penetrations, and MOV SI-20B will be rewired during the upcoming 1998 refueling outage. The spare conductors used to rewire the fans were "hand picked" for equal resistance, and the retest of the rewiring showed that the motor phase current splits evenly between the parallel #10AWG penetration conductors for both circuits. Valve SI-20B will also be rewired using "hand picked" spare conductors.

CAUSE OF THE EVENT

The manufacturer of the penetration, D.G. O'Brien, Inc, was contracted for assistance in identifying the cause of the penetration failure. The manufacturer identified the likely cause is original manufacture, and most probably due to the nature of the penetration's circuit conductor design. The F12 and A11 penetrations are multi-conductor #10AWG low voltage power penetrations. Each penetration conductor consists of a #10AWG insulated stranded pigtail wire crimped to a solid copper pin, the solid copper pin is soldered to a steel pin that is enclosed within a glass seal in the front face of the penetration, the steel pin is again soldered to a second solid copper pin, and the second solid copper pin is crimped to a #10AWG insulated stranded wire within the penetration. This sequence is identically repeated at the back face of the penetration resulting in eight electrical series connections; four crimped, and four soldered for the conductor circuit, pigtail end to pigtail end. This detail of construction is not shown on the drawings provided to Kewaunee by D.G. O'Brien during plant construction. The likely weak link identified by the manufacturer is at one of the soldered connections.

D.G. O'Brien informed Kewaunee that this circuit conductor design was used for all penetrations provided to Kewaunee that use #16AWG, #12AWG and #10AWG wires. Kewaunee verified that all #16AWG, #12AWG and #10AWG penetrations provided by D.G. O'Brien had 100% conductor continuity tests performed during production of the penetrations. However, the continuity tests were apparently "go / no-go" tests, and circuit resistance was not measured. Field measurements of spare conductors in the F12 and A11 penetrations using micro-ohm testing equipment showed significant variation from the expected resistance for some conductors, and these conductors had never been placed into service. It appears likely that one or more of the conductors

used in the original 1B Dome Vent Fan circuit had unsatisfactorily high resistance, and the circuit condition went undetected until failure eventually occurred.

ANALYSIS OF THE EVENT

This event is being reported under 10CFR50.73 (Other). The failure which is identified could be of interest to other licensee's with similar design and applications for containment penetrations.

The following provides the basis for the reportability determinations under 50.72 and 50.73:

> The A fan remained operable and the B fan containment penetration was not structurally damaged thereby satisfying plant accident mitigation functions of the systems. The Technical Specifications were not violated as a result of the failure. The impact of the failure only reduced the effectiveness of the associated train Hydrogen monitor [MON] [IP] which is a TS related item. However, the opposite train monitor remained fully functional to satisfy the minimum TS requirements. Therefore, no 10CFR50.72 or 73 reporting criteria were exceeded.

An assessment for the need to report the cause of the fan failure in accordance with 10CFR21 was performed. D.G. O'Brien was requested to assess the reportability aspect of the failure. D.G. O'Brien's conclusion was the condition is not reportable under Part 21 on the basis that one failure in 25 years does not constitute a Part 21 report.

In addition to the D.G. O'Brien assessment a further review of the Part 21 reporting criteria was performed by WPSC. Based upon this review and the failure assumptions provided by D.G. O'Brien it is agreed that a Part 21 report is not required. The failure assumptions are related to the fabrication process and also possibly the application of a continuous duty load in a parallel pin/conductor application.

The fabrication input to the failure is assessed as a poor crimp or solder joint in the conductor pin interface associated with the penetration assembly. The micro-ohm readings we have taken of penetrations confirm that there are inconsistencies in the resistances from one pin to another in our containment penetrations which support the failure mechanism assumed. However, to support the requirement that the condition would require a Part 21 report depends on if the condition found would be one that should have been found during the manufacturing and acceptance process or if it resulted from a departure from procurement requirements.

At the time of manufacture, the penetrations did undergo testing to determine continuity through the penetration. At the time it was not a practice to determine if there was consistency in the resistivity from one pin to another. This also was not a specification called out in the purchase order for the penetrations. Therefore, the quality of the penetrations manufactured and received were consistent with the design and testing at the time. There was no deviation in design or testing of the penetrations which should have been detected.

Regarding the application of the parallel pins for continuous duty applications; this again would be consistent with the knowledge and expectations for the applications at the time of installation. In theory there would have been no reason to question the potential load imbalances between the pins in a parallel application due to resistivity. Installation of electrical components at the time of construction would also not have been expected to be confirmed to the degree of checking resistivity in any applications.

In addition to the above, there is no guarantee that the increased resistance in the penetration connections is a function solely related to the manufacturing process. There exists the possibility that the increased resistance in the penetrations is time dependent. This can be neither confirmed or refuted, even though spare penetration conductors having inconsistent resistance readings exist, and even though they have never been placed into service.

Although we suspect that the resistance differences between pins contributes to heat generation at the conductor pin interface, it cannot be conclusively determined as the failure mechanism unless the entire penetration were removed for destructive analysis. Even then, there is no assurance that the condition could be confirmed. Disassembly of the penetration would have a significant impact on resources with no conclusive safety benefit. Therefore, declaring a safety significant impact of the penetration design consistent with Part 21 reporting criteria is inappropriate.

CORRECTIVE ACTIONS

Kewaunee has evaluated all in-service penetrations using #16AWG, #12AWG and #10AWG conductors. The #16AWG and #12AWG penetration conductors are extensively used for instrumentation and control applications. Resistance greater than design in these circuits have been determined to not be a threat to penetration integrity due to the low signal levels and low currents involved.

The #10AWG conductor penetrations are all used for 480VAC motor power circuits. All motors, except the containment dome vent fans, are either motor operated valves or motor circuits used only during refueling outages; only the dome fans are considered to be continuous duty motors. Motors that are called on to operate during reactor at-power operation, and have a full load current greater than or equal to 50% of the penetration continuous current rating will be measured using micro-ohm instrumentation during the upcoming 1998 refueling outage. Additionally, the motor circuit for MOV SI-20B will be rewired to spare penetration conductors during this outage.

The dome fans motor power circuits will be periodically monitored to verify that acceptable splitting of motor phase current continues to occur in the parallel penetration conductors involved. This is being done because it is not certain whether the observed unequal current split in the 1A fan parallel penetration conductors was due to the as-manufactured condition of the penetration conductors, or if it was service induced.

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TEXT *(If more space is required, use additional copies of NRC Form 366A)* (17)

Design consideration procedures used at Kewaunee are being updated to require that any future use of spare penetration conductors of #16AWG, #12AWG, or #10AWG wire size be verified to be within 10% resistance balance prior to use. This new requirement is at the recommendation of D.G. O'Brien, Inc.

ADDITIONAL INFORMATION

The following information is obtained from Kewaunee design drawings for the A11 and F12 containment electrical penetrations. No specific manufacturer model identification numbers were found.

D.G. O'Brien, Inc., Item 5 - Low Voltage Power (120) #10 Field Cond's Penetrations AWG, Code Identification No. 17476.

SIMILAR EVENTS

None.